

AMENDMENTS TO THE CLAIMS

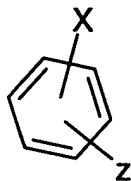
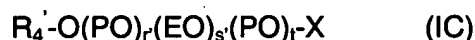
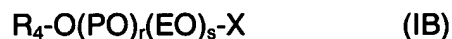
Claims 1 – 27 (Cancelled)

Claim 28 (Previously presented): A microcapsule comprising an encapsulated material enclosed within a solid permeable shell of a polymer resin wherein

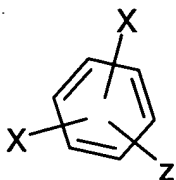
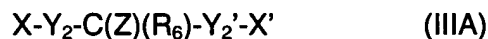
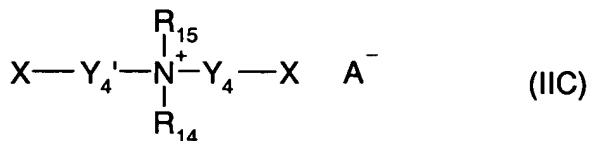
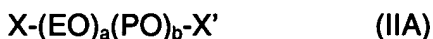
(a) said polymer resin is made by isocyanate polymerisation and the polymer resin has incorporated therein at least one surface modifying compound having a moiety – X as defined below which reacts with the isocyanate moiety in the wall forming material; or

(b) said polymer resin is made by the polymerisation of a urea formaldehyde prepolymer, in which the methylol ($-\text{CH}_2\text{OH}$) groups have optionally been partially etherified by reaction with a C_4 - C_{10} alkanol, and the polymer resin has incorporated therein at least one surface modifying compound having a moiety –X as defined below which reacts with the methylol or etherified methylol moieties in the urea formaldehyde wall forming material;

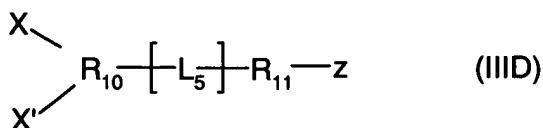
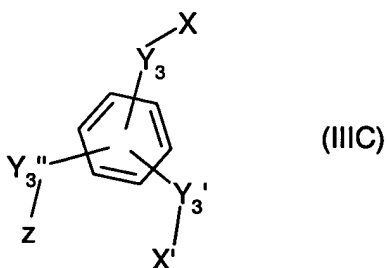
and wherein said surface modifying compound is of formula (IA), (IB), (IC), (ID), (IIA), (IIB), (IIC), (IIIA), (IIIB), (IIIC), (IIID) or (IVA) or is a sulfonate polyester polyol



(ID)



(IIIB)



wherein the sulfonate polyester polyol is prepared by reacting sodium sulphisophthalic acid, adipic acid, cyclohexane dimethanol, methoxy-polyethylene glycol (MW 750) and trimethylol propane to give a product having a hydroxyl number in the range of from 150 to 170;

and wherein in formulae (IA) to (IVA) above Z if present is sulphonate, carboxylate, phosphonate, phosphate, quaternary ammonium, betaine, oxyethylene or an oxyethylene-containing polymer;

and each X or X' is, independently, hydroxyl, thiol, a group -NHA wherein A is hydrogen, C₁ to C₄ alkyl or a group -CO-OR where R is hydrogen or a hydrocarbyl moiety having 1-30 carbon atoms optionally linked or substituted by one or more halo, amino, ether or thioether groups or combinations of these;

and wherein in formula (IA) Y₁ is a moiety linking X and Z and is a straight or branched alkyl chain containing from 1 to 20 carbon atoms or is phenyl, naphthyl, cyclopentyl or cyclohexyl;

and wherein in formula (IB) R₄ is an end-capping group which is C₁ to C₄ alkyl, r and s are independently from 0 to 3000, provided that s is not 0 and the total of r + s is from 7 to 3000, and EO and PO represent oxyethylene and oxypropylene respectively which may be arranged in random or block formation;

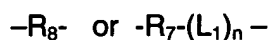
and wherein in formula (IC) R₄' is an end-capping group which is C₁ to C₄ alkyl, r', s' and t are, independently, from 0 to 2000, provided that s' is not 0 and the total of r' + s' + t is from 7 to 3000, and EO and PO represent oxyethylene and oxypropylene respectively;

and wherein formula (ID) X and Z are as defined above or if X and Z are adjacent substituents capable of reacting together they may form a cyclic anhydride capable of ring-opening under the reaction conditions;

and wherein in formula (IIA) a and b are independently from 0 to 3000, provided that a is not 0 and the total of a + b is from 7 to 3000, and EO and PO represent oxyethylene and oxypropylene respectively which may be arranged in random or block formation;

and wherein in formula (IIB) a', b' and c are, independently, from 0 to 2000, provided that b' is not 0 and the total of a' + b' + c is from 7 to 3000, and EO and PO represent oxyethylene and oxypropylene respectively;

and wherein in formula (IIC) R₁₄ and R₁₅, which may be the same or different, are hydrogen, C₁ to C₂₀ straight or branched chain alkyl, aryl or C₁ to C₄ aralkyl, wherein each aryl group may be optionally substituted by C₁ to C₄ alkyl, nitro or halo, and Y₄ and Y₄' which may be the same or different are



wherein R₇ and R₈ are, independently, C₁ to C₁₀ straight or branched chain alkyl linking groups optionally substituted by halogen or C₁ to C₄ alkoxy and (L₁)_n is a polyoxyalkylene group wherein n is from 2 to 20 and A⁻ is a suitable anion;

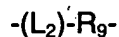
and wherein in formula (IIIA) R₆ is hydrogen or a C₁ to C₄ alkyl group optionally substituted by ether or halogen and Y₂ and Y₂', which may be same or different, are independently



wherein R₇ and R₈ are, independently, C₁ to C₁₀ straight or branched chain alkyl linking groups optionally substituted by halogen or C₁ to C₄ alkoxy and (L₁)_n is polyoxyethylene, polyoxypropylene or polyoxybutylene where n is from 2 to 20;

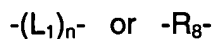
and wherein in formula (IIIB) X and Z are as previously defined;

and wherein in formula (IIIC) Y₃, Y₃' and Y₃'' individually represent a direct link between X or Z (as the case may be) and the ring structure or may be a group



where L₂ is an ester linking group -C(O)-O- and R₉ is oxyethylene, oxypropylene or oxybutylene or polyoxyethylene, polyoxypropylene or polyoxybutylene having a degree of polymerisation from 2 to 20;

and wherein in formula (IIID) R₁₀ is a C₁ to C₈ straight or branched chain alkyl group, the two groups X and X', which may be the same or different, may be attached to the same carbon atom in the alkyl chain or to different carbon atoms in the alkyl chain, -L₅- is a linking group which is



wherein R₈ and (L₁)_n are as defined above in relation to formula (IIIA) and R₁₁ is C₁ to C₄ alkyl;

and wherein in formula (IVA) Y and Y' are each, independently, a straight or branched chain C₁ to C₁₀ alkyl group, a polyoxyethylene, polyoxypropylene or polyoxybutylene polymer chain of formula -(L₁)_n- as defined above or a group -(L₂)-R₉- as defined above.

Claim 29 (Previously presented): A microcapsule according to claim 28 wherein

when -Z is sulphonate, carboxylate, phosphonate or phosphate it is present as a salt providing the -Z⁻ anion; or

when -Z is quaternary ammonium it has the structure



wherein R₁, R₂ and R₃ are independently hydrogen or C₁ to C₄ alkyl and A⁻ is a suitable inorganic or organic anion, provided that not more than one of R₁, R₂ and R₃ is hydrogen; or

when -Z is oxyethylene or an oxyethylene-containing polymer, it is an oxyethylene polymer or is a random or block oxyethylene/oxypropylene copolymer containing an oxyethylene to oxypropylene ratio of greater than 1.

Claim 30 (Previously presented): A microcapsule according to claim 28 wherein the polymer resin is made by isocyanate polymerisation and the isocyanate wall forming material is tolylene diisocyanate or an isomer thereof, phenylene diisocyanate or an isomer thereof, biphenylene diisocyanate or an isomer thereof, polymethylenepolyphenyleneisocyanate (PMPPI), hexamethylene diisocyanate (HMDI) or a trimer thereof or isophoronediiisocyanate (IPDI).

Claim 31 (Previously presented): A microcapsule according to claim 30 wherein the proportions of the surface modifying chemical relative to the wall forming material are such that there is an excess of total isocyanate groups present in the wall forming material over total groups -X.

Claim 32 (Previously presented): A microcapsule according to claim 31 wherein the ratio of the total moiety(ies) -NCO in the wall-forming material to the total reactive moiety(ies) -X in the surface modifying compound is from 2:1 to 25:1.

Claim 33 (Previously presented): A microcapsule according to claim 28 wherein the polymer resin is made by the polymerisation of a urea formaldehyde prepolymer and the mole ratio of the surface modifying agent to the number of urea-formaldehyde repeat units in the urea formaldehyde prepolymer is between 1:40 to 1:4.

Claim 34 (Currently amended): A modified process for the encapsulation of a dispersed material within a solid permeable shell of a polymer resin formed by polymerisation of a wall-forming material which comprises

(a) when said polymer resin is made by isocyanate polymerisation, incorporating therein at least one surface modifying compound as defined in claim 28 [4] having a moiety -X as defined in claim 28 [4] which reacts with the isocyanate moiety in the wall forming material; or

(b) when said polymer resin is made by the polymerisation of a urea formaldehyde prepolymer in which the methylol ($-\text{CH}_2\text{OH}$) groups have optionally been partially etherified by reaction with a $\text{C}_4\text{-C}_{10}$ alkanol, incorporating therein at least one surface modifying compound as defined in claim 28 [4] having a moiety $-\text{X}$ as defined in claim 28 [4] which reacts with the methylol or etherified methylol moieties in the urea formaldehyde wall forming material.

Claim 35 (Previously presented): A process according to claim 34 comprising

(a) reacting the surface-modifying compound with at least one wall-forming material thereby forming a modified surface-active intermediate;

(b) preparing an organic solution or oil phase comprising the material to be encapsulated, the modified surface-active intermediate, and, optionally, additional wall-forming material;

(c) creating an emulsion of the organic solution in a continuous phase aqueous solution comprising water and, optionally, a protective colloid, wherein the emulsion comprises discrete droplets of the organic solution dispersed throughout the continuous phase aqueous solution, with an interface formed between the discrete droplets of organic solution and the aqueous solution; and either

(d) causing *in situ* polymerization and/or curing of the modified wall-forming material in the organic solution of the discrete droplets at the interface with the aqueous solution by heating the emulsion for a sufficient period of time and optionally adjusting the pH to a suitable value to allow substantial completion of wall formation, thereby converting the organic solution droplets to capsules consisting of solid, permeable, polymer shells enclosing the material and having the surface modifying compound incorporated therein; or as an alternative to (d)

(e) causing polymerization at the oil-water interface by bringing together a wall forming material added through the aqueous continuous phase and capable of reacting with the wall forming material(s) in the discontinuous oil phase.

Claim 36 (Previously presented): A process according to claim 34 comprising

(a) preparing an organic solution or oil phase comprising the material to be encapsulated, the surface modifying compound and the wall-forming material;

(b) creating an emulsion of the organic solution in a continuous phase aqueous solution comprising water and, optionally, a protective colloid, wherein the emulsion comprises discrete droplets of the organic solution dispersed throughout the continuous phase aqueous solution, with an interface formed between the discrete droplets of organic solution and the aqueous solution; and either

(c) causing *in situ* polymerization and/or curing of the modified wall-forming material in the organic solution of the discrete droplets at the interface with the aqueous solution by heating the emulsion for a sufficient period of time and optionally adjusting the pH to a suitable value to allow substantial completion of wall formation, thereby converting the organic solution droplets to capsules consisting of solid, permeable, modified polymer shells enclosing the material; or as an alternative to (c)

(d) causing polymerization at the oil-water interface by bringing together a wall forming material added through the aqueous continuous phase and capable of reacting with the wall forming material(s) in the discontinuous oil phase.

Claim 37 (Previously presented): A process according to claim 34 comprising

(a) preparing an organic solution or oil phase comprising the material to be encapsulated and the wall-forming material;

(b) creating an emulsion of the organic solution in a continuous phase aqueous solution comprising water and the surface-modifying compound(s), wherein the emulsion comprises discrete droplets of the organic solution dispersed throughout the continuous phase aqueous solution, with an interface formed between the discrete droplets of organic solution and the aqueous solution; and

(c) causing *in situ* polymerization and/or curing of the wall-forming material so that the surface-modifying molecule(s) is incorporated into the wall by heating the emulsion for a sufficient period of time and optionally adjusting the pH to a suitable value, to allow substantial completion of wall formation, thereby converting the organic solution droplets to capsules consisting of solid, permeable, modified polymer shells enclosing the material.

Claim 38 (Previously presented): A process according to claim 34 comprising

(a) preparing an organic solution or oil phase comprising the material to be encapsulated and a first wall-forming material(s);

(b) creating an emulsion of the organic solution in a continuous phase aqueous solution comprising water and the surface-modifying compound(s), wherein the emulsion comprises discrete droplets of the organic solution dispersed throughout the continuous phase aqueous solution, with an interface formed between the discrete droplets of organic solution and the aqueous solution whereupon the surface modifying compounds(s) react at the interface with wall forming material from the organic phase; and

(c) causing polymerization at the oil-water interface by bringing together a second wall forming material added through the aqueous continuous phase and capable of reacting with the first wall forming material(s) in the discontinuous oil phase.

Claim 39 (Previously presented): A process according to claim 34 wherein there is employed a combination of the processes selected from at least two of the following:

1) a process comprising

- a) reacting the surface-modifying compound with at least one wall-forming material thereby forming a modified surface-active intermediate;
- b) preparing an organic solution or oil phase comprising the material to be encapsulated, the modified surface-active intermediate, and, optionally, additional wall-forming material;
- c) creating an emulsion of the organic solution in a continuous phase aqueous solution comprising water and, optionally, a protective colloid, wherein the emulsion comprises discrete droplets of the organic solution dispersed throughout the continuous phase aqueous solution, with an interface formed between the discrete droplets of organic solution and the aqueous solution; and either
- d) causing *in situ* polymerization and/or curing of the modified wall-forming material in the organic solution of the discrete droplets at the interface with the aqueous solution by heating the emulsion for a sufficient period of time and optionally adjusting the pH to a suitable value to allow substantial completion of wall formation, thereby converting the organic solution droplets to capsules consisting of solid, permeable, polymer shells enclosing the material and having the surface modifying compound incorporated therein, or as an alternative to (d)
- e) causing polymerization at the oil-water interface by bringing together a wall forming material added through the aqueous continuous phase and capable of reacting with the wall forming material(s) in the discontinuous oil phase;

2) a process comprising

- a) preparing an organic solution or oil phase comprising the material to be encapsulated, the surface modifying compound and the wall-forming material
- b) creating an emulsion of the organic solution in a continuous phase aqueous solution comprising water and, optionally, a protective colloid, wherein the emulsion comprises discrete droplets of the organic solution dispersed throughout the continuous phase aqueous solution, with an interface formed between the discrete droplets of organic solution and the aqueous solution; and either
- c) causing *in situ* polymerization and/or curing of the modified wall-forming material in the organic solution of the discrete droplets at the interface with the aqueous solution by heating the emulsion for a sufficient period of time and optionally adjusting the pH to a suitable value to allow substantial completion of wall formation, thereby converting the organic solution

droplets to capsules consisting of solid, permeable, modified polymer shells enclosing the material; or as an alternative to (c)

- (d) causing polymerization at the oil-water interface by bringing together a wall forming material added through the aqueous continuous phase and capable of reacting with the wall forming material(s) in the discontinuous oil phase;

3) a process comprising

- a) preparing an organic solution or oil phase comprising the material to be encapsulated and the wall-forming material;
- b) creating an emulsion of the organic solution in a continuous phase aqueous solution comprising water and the surface-modifying compound(s), wherein the emulsion comprises discrete droplets of the organic solution dispersed throughout the continuous phase aqueous solution, with an interface formed between the discrete droplets of organic solution and the aqueous solution; and
- c) causing *in situ* polymerization and/or curing of the wall-forming material so that the surface-modifying molecule(s) is incorporated into the wall by heating the emulsion for a sufficient period of time and optionally adjusting the pH to a suitable value, to allow substantial completion of wall formation, thereby converting the organic solution droplets to capsules consisting of solid, permeable, modified polymer shells enclosing the material; and

4) a process comprising

- a) preparing an organic solution or oil phase comprising the material to be encapsulated and a first wall-forming material(s) ;
- b) creating an emulsion of the organic solution in a continuous phase aqueous solution comprising water and the surface-modifying compound(s), wherein the emulsion comprises discrete droplets of the organic solution dispersed throughout the continuous phase aqueous solution, with an interface formed between the discrete droplets of organic solution and the aqueous solution whereupon the surface modifying compounds(s) react at the interface with wall forming material from the organic phase; and
- c) causing polymerization at the oil-water interface by bringing together a second wall forming material added through the aqueous continuous phase and capable of reacting with the first wall forming material(s) in the discontinuous oil phase.

Claim 40 (Previously presented): The reaction product of a surface modifying compound as defined in claim 28 and an isocyanate wall forming material or a urea formaldehyde prepolymer in which the methylol ($-\text{CH}_2\text{OH}$) groups have optionally been partially etherified by reaction with a $\text{C}_4\text{-C}_{10}$ alkanol.

Claim 41 (Previously presented): A microcapsule according to claim 28 wherein the encapsulated material is an agrochemical, an ink, a dye, a biologically active material or a pharmaceutical.

Claim 42 (Previously presented): A process according to claim 34 wherein the encapsulated material is an agrochemical, an ink, a dye, a biologically active material or a pharmaceutical.

Claim 43 (Previously presented): A method for modifying the soil mobility of an agrochemical which comprises encapsulating the agrochemical in a process according to claim 34 and modifying the surface properties by incorporating a surface modifying compound.